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FC

EVALUATION OF THE ESCAPE SYSTEMS FOR THE B-52 AND RB-52 AIRPLANES

BY

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American Machine & Foundry Company

PROJECT TS1-15

PITMAN-DUNN LABORATORIES GROUP
FRANKFORD ARSENAL
Philadelphia, Pa.

January 1957

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REPORT R-1363

EVALUATION OF THE ESCAPE SYSTEMS FOR THE B-52 AND RB-52 AIRPLANES

Project TS1-15

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FOREWORD

The final report on the Development and Evaluation of the Escape Systems for the B-52 and RB-52 airplanes was prepared by the Mechanics Research Department of the American Machine & Foundry Company as Activity 5 of Task II, Contract DA-11-022-ORD-1604. The development studies reported herein, with the exception of the evaluation of the RB-52 system, were conducted at the Pitman-Dunn Laboratories of Frankford Arsenal. The evaluation of the RB-52 system was conducted at the Ballistic Test Station of the Mechanics Research Department of American Machine & Foundry Company as Activity 3, Task I of the above contract. This report includes the compilation, analysis, and interpretation of experimental data.

OBJECT

To develop and evaluate an escape system

SUMMARY

The escape systems for the B-52 and RB-52 airplanes comprise various subsystems providing for emergency escape of several crewmen. Numerous "get ready" operations, such as seat positioning, equipment stowage, hatch jettison, etc., are performed in each subsystem prior to ejection of the crewman. Each subsystem consists of several cartridge actuated devices, such as initiators, thrusters, and catapults. The devices are connected with lengths of hose or tube or by mechanical linkage to an aircraft component set in motion. The details of each subsystem and the estimated or measured pressure at the inlet of each cartridge actuated device are presented.

AUTHORIZATION

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INTRODUCTION

The provision for personnel escape from fighter aircraft led to the development of relatively simple systems for canopy removal and seat ejection. In these systems two separate operations were required, with a mechanical interlock to assure the order of actuation.

The development of the escape system for bomber aircraft required consideration of numerous complex problems, such as initiation of the escape system from several points, provision for escape of many crewmen and for stowage of equipment, orientation of crewmen with respect to escape exit, and for delay or pause in escape sequence.

The escape system consists of series and parallel operations which were synchronized and safety interlocked. The escape systems of the B-52 and RB-52 airplanes, the most complex of the systems developed to date, comprise several subsystems which provide for the numerous functions indicated above.(1)* Various modifications (2) were made to the systems during the development; improvements or simplifications were incorporated based on experimental tests.(3) The developments of the individual devices which are contained in the system are discussed in separate reports (see references).

The assembly of each subsystem of the escape system, description of operation, and measured performance are presented in this report for the B-52 and RB-52 airplanes.

B-52 AIRPLANE ESCAPE SYSTEM

The escape system for a B-52 airplane is composed of several subsystems which provide for escape of a navigator, bombardier, pilot, copilot, electronic reconnaissance operators, electronic counter measures operators, and tail gunner. Each subsystem can be operated independently of the other subsystem.

*See references attached

All the subsystems are actuated by mechanical functioning of an initiator and are similar in that they have a "get ready" phase and an "ejection phase". When the subsystem sequence is started, all "get ready" operations are completed in an orderly sequence. Then, at the option of the crewman, ejection of the seat is initiated.

Each subsystem consists of a series of cartridge actuated devices assembled for either series or parallel operations. Several of the devices are connected to each other with lengths of tube or hose, so that propellent gas from one device will trigger another. Other devices are triggered mechanically as some aircraft component is moved by a cartridge actuated device. The length of hose between devices is within the permissible limit to assure reliable firing of the device at the terminal end of the hose. Although gas pressures of only 300 to 600 psi are required at the inlet port of cartridge actuated devices to fire them, a minimum of 1000 psi at -65° F is generally specified. Where acceptable pressure levels are not assured, "booster" devices (gas-operated initiators) are used.

Pilot and Copilot Escape Subsystems

A schematic layout of the pilot and copilot escape subsystems is shown in Figure 1. These subsystems are equivalent with the exception of a single hose assembly, as indicated in the legend of the figure. The system provides for escape by upward ejection from the aircraft. The "get ready" operations include disconnect of two electric actuators, positioning of the seat, and jettisoning of a hatch. The schematic is based on the information presented in drawing DLX10660, (reference: Boeing drawing 5-52395).

Estimates of the pressure are given at the inlet of each cartridge actuated device and are made on the basis of experimental data obtained during the evaluation of the pressure-length relations for M3 initiators[4] and M5A1 thruster.[5] (These estimates are indicated in the legend).

The escape sequence is started by mechanically triggering an M3 initiator, [1c]*. Propellent gas from the device

*Numbers within brackets refer to specific components found in the figure presenting the subsystem under discussion.

flows through a flexible hose to fire an M3A1 thruster [16a] which, on functioning, disconnects an electric actuator. At the end of stroke, propellent gas flows from the M3A1 thruster through a length of hose to fire an M2A1 thruster [18], which positions the pilot's seat with respect to the escape hatch. The terminal velocity of the seat is limited by an oil type damper. When the seat moves, an M3 initiator, connected by a lanyard, is fired. Propellent gas from this device flows through a hose system (which includes a tee, disconnect, and unions) to trigger an M5A1 initiator [13] and an M3A1 thruster [16b]. The initiator acts as a booster in the hose system. The operation of the thruster disconnects an electric actuator. Propellent gas from the M3 initiator triggers an M1A1 thruster [7] which jettisons a hatch.

Bombardier and Navigator Escape Subsystems

A schematic of the bombardier and navigator escape subsystems is shown in Figure 2; the information is taken from drawings DLX10644 and DLX10642 (reference Boeing drawing 5-52396). These systems are similar except for a length of hose (MS28741-4), as shown in the legend. This system provides for escape by downward ejection. The "get ready" operations comprise positioning of a seat and jettisoning of a hatch. Estimated pressures at the inlet of each cartridge actuated device are shown.

The escape sequence is started by mechanical triggering of an M3 initiator [5a]. Propellent gas from this device flows through a length of hose to fire an M2A1 thruster [2], which positions a seat with respect to guide rails and escape exit (hatch). As the seat moves, the firing pin of an M3 initiator [5b] is pulled. Propellent gas from this initiator flows through a hose and tube system to trigger an M1A1 thruster [11], which jettisons a hatch. A disconnect [6] is provided in the hose system to permit separation when the hatch separates from the airplane. As the hatch moves, an M3 initiator [5d] is triggered (lanyard connection), which operates a piston type device [15], which removes a safety from another M3 initiator [5c]. At this point, all "get ready" operations are completed. The M3 initiator [5c] is then mechanically fired by the crewman to trigger an M4 catapult [14] for downward ejection.

In the first three airplanes in which the escape system was installed, the length of hose [4d] in the navigator system

was 192 inches. In later installations, the hose length was reduced to 178 inches.

TAIL CONE JETTISON SUBSYSTEM

The tail cone jettison subsystem provides a means of escape for the tail gunner. Physical ejection of the crewman is not required. A schematic of the subsystem is presented in Figure 3.

The escape sequence is started by mechanical triggering of an M3 initiator [8a] which provides propellent gas to operate a piston type device to trigger a dump valve. Concurrently, propellent gas flows through a tube system to trigger an M6A1 initiator [15]. The tube consists of several lengths of stainless steel tube, elbow, tee, and various unions. After approximately two seconds, during which time the compartment pressure is lowered, the M6A1 initiator fires. Propellent gas from this device triggers an M1A1 thruster [9] which unlocks the tail turret and mechanically pulls the firing pin of an M3 initiator [8b]. Propellent gas from the initiator flows through a dual tube system to fire two M5A1 thrusters [1a and 1b] which jettison the tail cone.

An M3 initiator [8c] connects into the system with a length of flexible hose at a tee following the delay initiator [15]. The M3 initiator serves as an exterior trigger for ground operation for tail cone jettison by supplying propellent gas to operate the M1A1 thruster [9].

Measurements of pressure at the inlet port of each device were not taken. Function tests were performed, however, indicating satisfactory operation of the system.

Electronic Counter Measures Operator Escape Subsystem

This system provides for escape of the electronic counter measures operator by upward ejection from the aircraft. This system (Figure 4) is similar to the pilot system (Figure 1) except for the elimination of one cartridge actuated device (an M3A1 thruster) and a few variations in length of hose. Hence, a discussion of the system has been omitted.

RB-52 AIRPLANE ESCAPE SYSTEM

In addition to the systems discussed in the previous section, the reconnaissance bomber, RB-52, requires a system for escape of electronic reconnaissance operators by downward ejection.

Hatch Jettison and Downward Seat Capsule Subsystem

The subsystem is shown in Figure 5 and represents the most complex of those developed to date. The escape sequence is initiated by either of two electronic reconnaissance operators (parallel operation) by mechanically triggering an M3 initiator [1a or 1b]. Propellent gas from either initiator passes through a tube system to function a piston-type device [9a], which triggers a dump valve. Concurrently, gas from the same source fires an M10 delay initiator. During the two seconds while the delay functions, the compartment pressure is reduced by escape of air through a dump valve. At the end of this period, the charge of the M10 initiator burns and the gas produced flows through the connecting tube system to trigger an M1A1 thruster [17]. The operation of the thruster unlocks a hatch and mechanically fires an M3 initiator [1c] connected by a lanyard. The gas produced by this initiator fires an M5A1 thruster [18], which jettisons the hatch. As the hatch moves, an M3 initiator [1e], connected by a lanyard, is fired. The gas from this device flows through parallel tube systems to operate two piston-type devices [9b and 9c] which "unsafety" two M3 initiators [1d and 1f]. This latter operation makes it possible for each crewman to fire his M4 catapult [19a or 19b] by mechanically firing the M3 initiator. Hence, downward ejection is accomplished for escape from the airplane.

The "get ready" operations in this system provide for compartment pressure equalization, unlock and jettison of the hatch. Check valves are provided in the dual tube system leading from M3 initiators which are used to start the escape sequence. These valves permit the flow of gas in one direction only; hence, the gas produced by a single initiator is excluded from the parallel tube section beyond the check valve. A disconnect [4] is provided for separation of the tube when the seat is ejected downward.

It is of interest to note that the firing of both M3 initiators [1c and 1b] to start the escape sequence produces pressures approximately 50 per cent higher at the inlet of the cartridge [A] and piston [B] devices.

EVALUATION PROCEDURE

Measurements of pressure vs time were taken at the inlet port of each cartridge actuated and piston type device, using a ferrule gage as sensing element.* Round by round data are presented in the Appendix. The average pressures are summarized in Figure 5.

Segments of the subsystem were mounted on peg boards and wrapped in plastic sheets. Each assembly was conditioned for at least 8 hours at -65° F and fired within three minutes after removal from the conditioning box, except as noted.

New components were used in all test firings, except as noted. Dummy cartridges (primer only) were loaded in the terminal cartridge actuated devices. After each firing, the cartridge was examined for primer function. No failures to fire were observed. All cartridge actuated devices functioned satisfactorily; no unusual occurrences were observed.

*The output of the gage was amplified and fed into a cathode ray oscilloscape. The trace was recorded with a continuous strip moving film camera (Fairchild - 35 mm). The time signal was impressed on the trace with Z-axis modulation.

APPENDIX

ROUND BY ROUND DATA

RB-52 ESCAPE SYSTEM
(Conditioning Temperature, -65° F)

Pressure Determination at D (Figure 5)

Assembly: M3 initiator [1c]; 14 in. hose [6d]; M5A1 thruster [18]

Round No.	Set-up Time (sec)	Pressure (psi) Shear	Pressure (psi) Maximum	Time (millesecond)* Shear	Time (millesecond)* Maximum
1**	170	280	4490	2	24
2**	139	360	4430	3	29
3**	257	240	4910	2	27
4	160	280	5150	2	25
5	171	290	5540	2	27

Good indent on primer. Primer fired

*Time from beginning of pressure rise.
**Slight leak near pressure gage.

Pressure Determination at E (Figure 5)

Assembly: M3 initiator [1d]; 24 in. tubing [3i]; M4 catapult [19a]

Round No.	Set-up Time (sec)	Pressure (psi) Shear	Pressure (psi) Maximum	Time (millesecond) Shear	Time (millesecond) Maximum
6	185	940	3370	6	28
7	138	750	3090	4	31
8	162	960	3230	7	33
9	163	960	3160	7	32
10	161	950	3240	5	28

Good indent on primer. Primer fired

ROUND BY ROUND DATA (Cont'd)

Pressure Determination at F and G (Figure 5)

Assembly: M3 initiator [1e]; 3 in. steel tubing [3d]; tee [22]; 26.4 in. [6e] and 20 in. [6f] hose; unions [5]; 18 in. [3j] and 7 in. [3k] steel tube

Round No.	Set-up Time (sec)	Maximum Pressure (psi) F	G	Time (millisecond)* to Maximum Pressure
11	271	2210	2250	33
12	165	2100	2130	41
13	185	2100	2130	36
14	205	2050	2130	35
15	145	2170	2260	27

*Time to maximum pressure at location F and G are equal

Pressure Determination at A and C (Figure 5)

Assembly: M3 initiator [1a]; 12 in. steel tube [3a]; Wiggins coupling [4]; 14 in. steel tube [3b]; union [5]; 30 in. hose [6a]; valve [8]; 11 in. steel tube [3c]; cross [10]; 17.75 in. steel tube [3d, 3e and 3L]; union [11]; M10 initiator [12]; 24 in. steel tube [3f]; elbow [15]; 8 in. steel tube [3g]; Wiggins coupling [4]; 10.75 in. hose [6g]; 11 in. steel tube [3h]; elbow [15]; 32 in. hose [6c]; union [16]; M1A1 thruster [17].

Round No.	Set-up Time (sec)	Pressure (psi) A Shear	A Max	C Shear*	C Max	Time (millisecond) A Shear*	C Shear	C Max**
16	173	530	950	490	850	17	29	2.99
17	243	650	1160	260	880	17	20	3.02
18	210	650	1020	350	1000	17	17	2.90
19	217	610	1120	360	980	17	21	2.88
20	198	630	1060	430	1160	17	17	2.69

*Time from beginning of pulse to time of shear.
**Time from beginning of pulse at A to time peak pressure at C (second).

ROUND BY ROUND DATA (Cont'd)

Pressure Determination at A and B (Figure 5)

Assembly: M3 initiator [1a]; 12 inches steel tube [3a]; Wiggins coupling [4]; 14 inches steel tube [3b]; union [5]; 30 inches hose [6a]; valve [8]; 11 inches steel tube [3c]; cross [10]; 17.75 inches steel tube [3d, 3e and 3L]; union [11]; M10 initiator [12].

Round No.*	Set-up Time (sec)	Maximum Pressure (psi) A Shear	A Max	B Max	Time (millisecond) A Shear
22**	190	700	1190	1200	8
23**	184	560	970	860	14
24**	177	650	1060	1010	7

** Slight leak observed.

Pressure Determination at A and B (Figure 5)

Dual Initiator System

Round No.	Set-up Time (sec)	Maximum Pressure (psi) A Shear	A Max	B Max	Time (millisecond) A Shear
25	183	630	1700	1650	18
26*	194	690	1060	1020	18
27	178	740	1610	1550	16
28	137	520	1700	1590	7

*One check valve stuck.

Rounds 22-28 reconditioned component used

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4. L. D. Sachs, "Development and Evaluation of Initiators, M3 and M5A1," Frankford Arsenal Report R-1324, June 56.

5. L. R. Henry and L. D. Sachs, "Ballistic and Mechanical Development of Thruster, M3A1," Frankford Arsenal Report R-1338, May 56.

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8. L. R. Henry and L. D. Sachs, "Ballistic and Mechanical Development of Thruster, M2A1, "Frankford Arsenal Report R-1343, May 56.

9. L. R. Henry and L. D. Sachs, "Ballistic and Mechanical Development of Thruster, M5A1, "Frankford Arsenal Report R-1331, Feb 56.

10. L. D. Sachs, "Development and Evaluation of Delay Initiators, M4 and M6A1, "Frankford Arsenal Report R-1344, June 56.

Pilot and Copilot Escape Subsystem
(Figure 1)

1. Initiator, M3
2. Hose assembly, MS28741-4
   a. Length, 59.0 in.*
   b. Length, 52.0 in.
   c. Length, 43.0 in.
   d. Length, 44.0 in.
   e. Length, 14.0 in.
   f. Length, 40.5 in.
   g. Length, 20.0 in.
   h. Length, 32.0 in.
   i. Length, 32.0 in.
3. Cylinder, Initiator, Boeing Airplane Co. Dwg 6-62493-1
4. Elbow, AN822-4
5. Catapult, M3
6. Damper, Boeing Airplane Co. Dwg 9-38926-1
7. Thruster, M1A1
8. Elbow, AN833-4
   Nut, AN6289-4
   Gasket, AN6290-4
   Ring, AN6291-4
9. Nut, AN818-4
   Sleeve, AN819-4
10. Tubing, corrosion resisting, 1/4 in. OD, 0.049 in. wall, 7 in. long, Spec MIL-T-8506, Type I.
11. Union, AN815-4
12. Wiggins coupling assembly, 8-101, 8-110
13. Initiator, M5A1
14. Nut, AN6289-4
    Gasket, AN6290-4
    Ring, AN6291-4
15. Tee, AN804-4
16. Thruster, M3A1
17. Plug and Bleeder, AN814-4
    Gasket, AN902-4
18. Thruster, M2A1
19. Union, AN815-4
    Gasket, AN6290-4
20. Damper, Boeing Airplane Co. Dwg 9-41246-1

PRESSURE DATA

Location	Pressure (psi)
A	3250(1)
B	4700(1)
C	1500(1)
D	(2)
E	(2)
F	3270
G	(2)

(1) Estimated

(2) Not measured

*For copilot, 57.5 in.

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R-1363

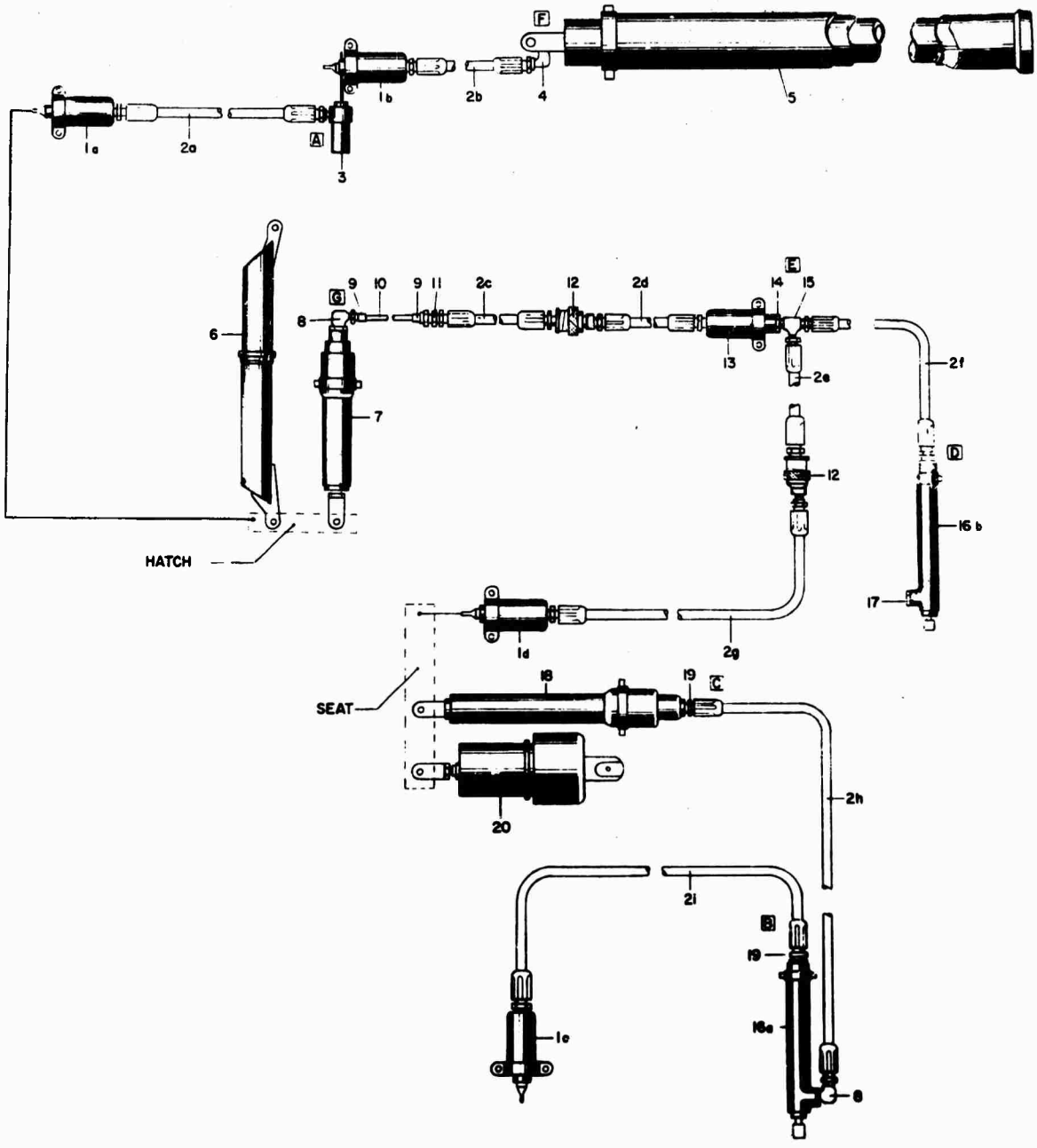

Figure 1. Pilot and copilot escape subsystem, B-52 Airplane

Bombardier and Navigator Escape Subsystem
(Figure 2)

1. Damper, downward seat, Boeing Airplane Co. Dwg 9-41246-1
2. Thruster, M2A1
3. Elbow, AN833-4
   Nut, AN6289-4
   Gasket, AN6290-4
   Ring, AN6291-4
4. Hose assembly, MS28741-4
   a. Length, 65.5 in.
   b. Length, 28.0 in. (Navigator, 42.5 in.)
   c. Length, 37.5 in. (Navigator, 32.0 in.)
   d. Length, 198.0 in. (Navigator, 178.0 in.)
5. Initiator, M3
6. Wiggins coupling assembly, 8-101, 8-110
7. Union, AN815-4
8. Nut, AN818-4
   Sleeve, AN819-4
9. Tubing, corrosion resisting 1/4 in. OD, 0.028 in. wall. 4 in. long, Spec MIL-T-8506, Type I
10. Elbow, AN833-4
    Nut, AN6289-4
    Gasket, AN6290-4
    Ring, AN6291-4
11. Thruster, M1A1
12. Tubing, corrosion resisting, 1/4 in. OD, 0.049 in. wall, 32 in. long, Spec MIL-T-8506, Type I
13. Elbow, AN822-4
14. Catapult, M4
15. Cylinder, Initiator, Boeing Airplane Co Dwg 6-62493-1

PRESSURE DATA

Location	Pressure (psi)
A	3000(1)
B	1050(1)
C	4370(1)
D	(2)

(1) Estimated

(2) Not measured

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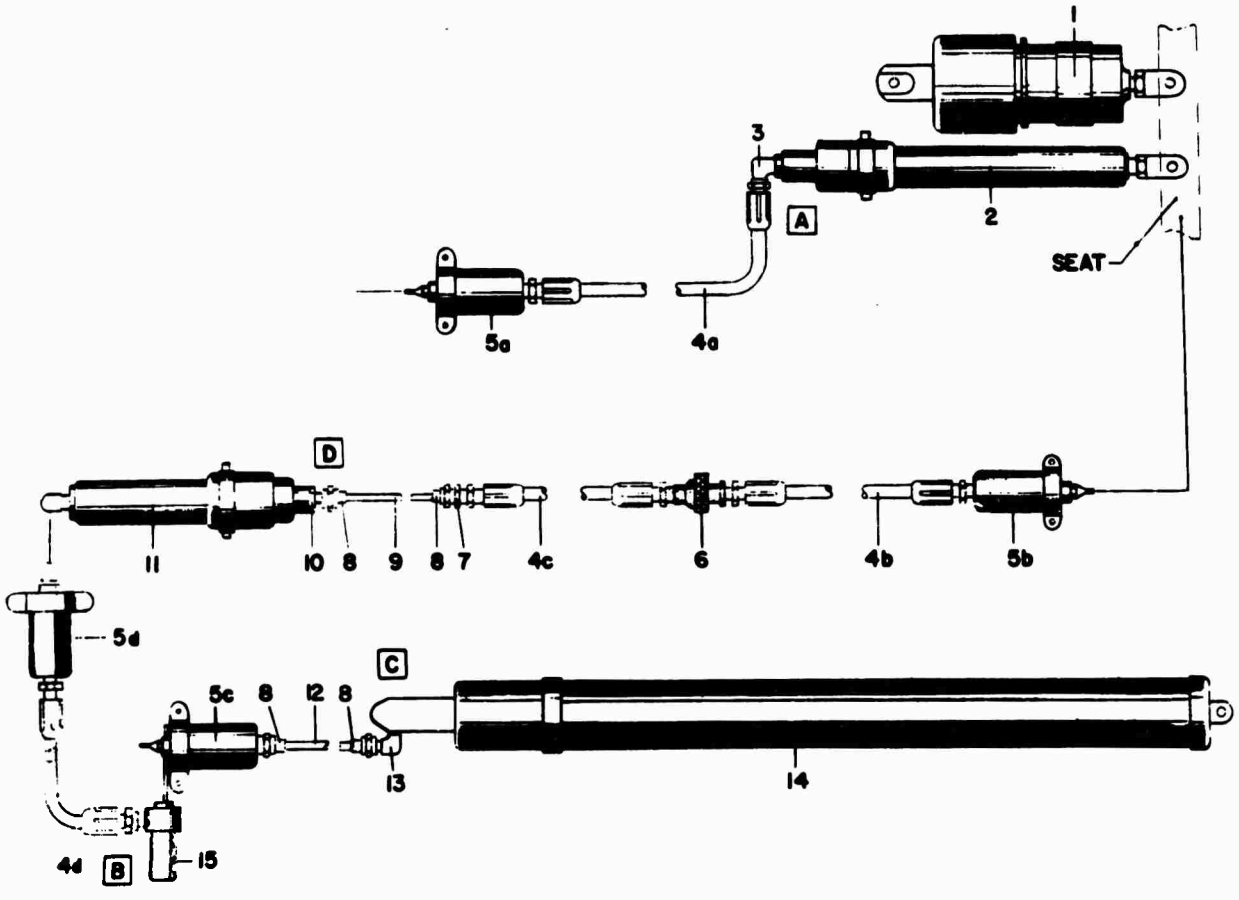

Figure 2. Bombardier and navigator escape subsystems, B-52 Airplane

Tail Cone Jettison Subsystem
(Figure 3)

1. Thruster, M5A1
2. Union, AN815-4
   Gasket, AN6290-4
3. Hose assembly, MS28741-4
   a. Length, 28.0 in.
   b. Length, 25.0 in.
   c. Length, 32.0 in.
   d. Length, 28.0 in.
   e. Length, 26.0 in.
4. Union, AN832-4
   Nut, AN924-4
5. Tee, AN824-4
6. Nut, AN818-4
   Sleeve, AN819-4
7. Tubing, corrosion resisting, 1/4 in. OD, 0.049 in. wall, Spec MIL-T-8506, Type I
   a. Length, 12.0 in.
   b. Length, 11.0 in.
   c. Length, 15.0 in.
   d. Length, 10.0 in.
   e. Length, 14.0 in.
   f. Length, 2.0 in.
   g. Length, 13.0 in.
   h. Length, 6.0 in.
8. Initiator, M3
9. Thruster, M1A1
10. Union, AN832-4
    Nut, AN6289-4
    Ring, AN6291-4
    Gasket, AN6290-4
11. Valve, AN6249-4
12. Elbow, AN837-4
    Nut, AN924-4
    Washer, AN960-D716
13. Tee, AN784-4
14. Nut, AN6289-4
    Gasket, AN6290-4
    Ring, AN6291-4
15. Initiator, Delay, M6A1
16. Cylinder, Initiator, Boeing Airplane Co. Dwg 6-62493-1

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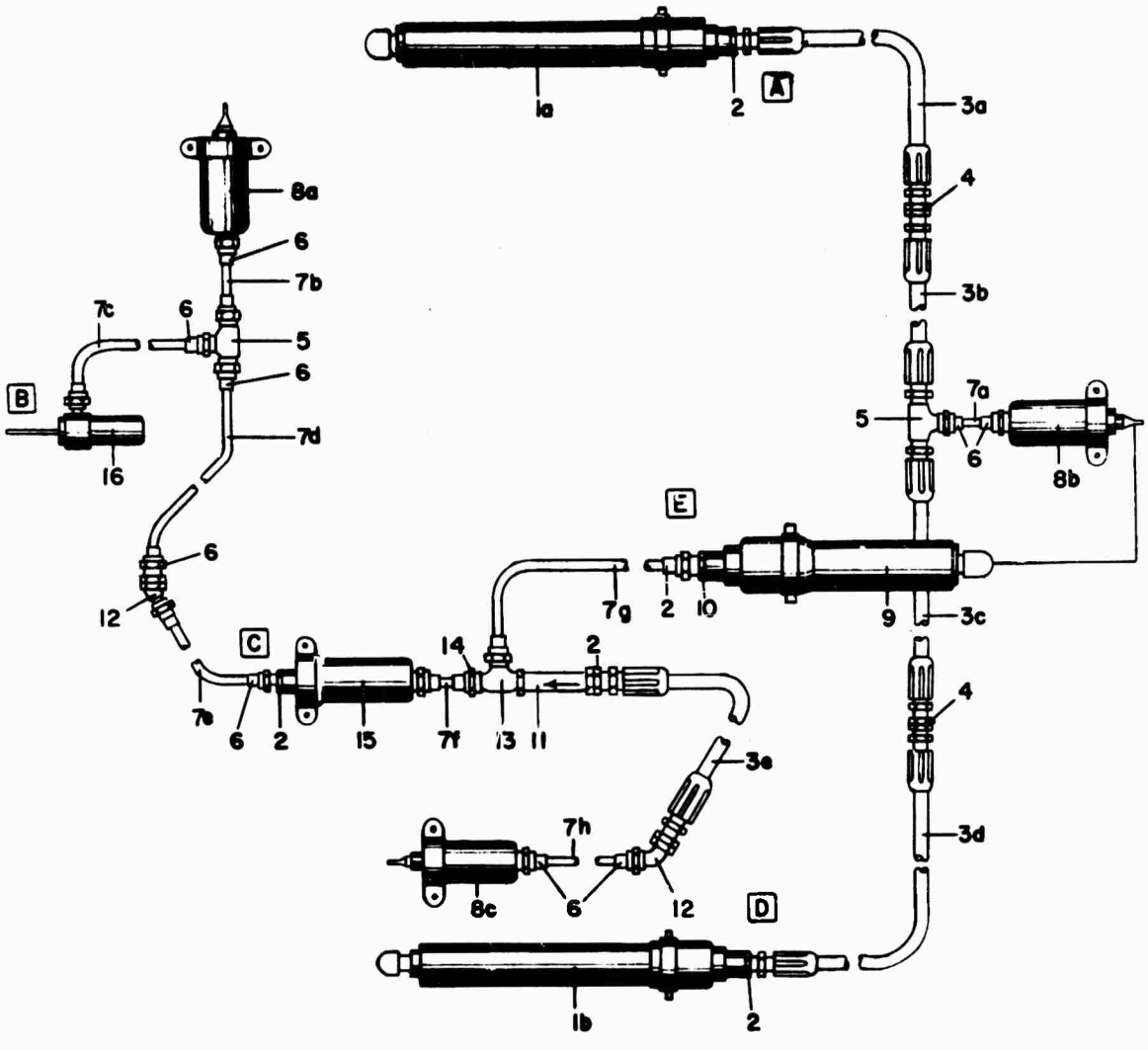

Figure 3. Tail cone jettison subsystem, B-52 Airplane

Electronic Counter Measures Operator Escape Subsystem
(Figure 4)

1. Initiator, M3
2. Hose assembly, MS28741-4
   a. Length, 57.0 in.
   b. Length, 30.0 in.
   c. Length, 40.5 in.
   d. Length, 26.0 in.
   e. Length, 23.0 in.
   f. Length, 20.0 in.
   g. Length, 32.0 in.
   h. Length, 32.0 in.
3. Cylinder, Initiator, Boeing Airplane Co Dwg 6-62493-1
4. Elbow, AN822-4
5. Catapult, M3
6. Damper, Boeing Airplane Co Dwg 6-62493-1
7. Thruster, M1A1
8. Elbow, AN833-4
   Nut, AN6289-4
   Gasket, AN6290-4
   Ring, AN6291-4
9. Nut, AN818-4
   Sleeve, AN819-4
10. Tubing, corrosion resisting, 1/4 in. OD, 0.049 in. wall, 7 in. long, Spec MIL-T-8506 Type I
11. Union, AN815-4
12. Wiggins coupling assembly, 8-101, 8-110
13. Initiator, M5A1
14. Union, AN815-4
    Gasket, AN6290-4
15. Thruster, M2A1
16. Damper, Boeing Airplane Co Dwg 9-41246-1
17. Thruster, M3A1

PRESSURE DATA

Location	Pressure (psi)
A	3350(1)
B	4700(1)
C	1500(1)
D	(2)
E	4420(1)
F	(2)

(1) Estimated

(2) Not measured

Neg. #30888
R-1363

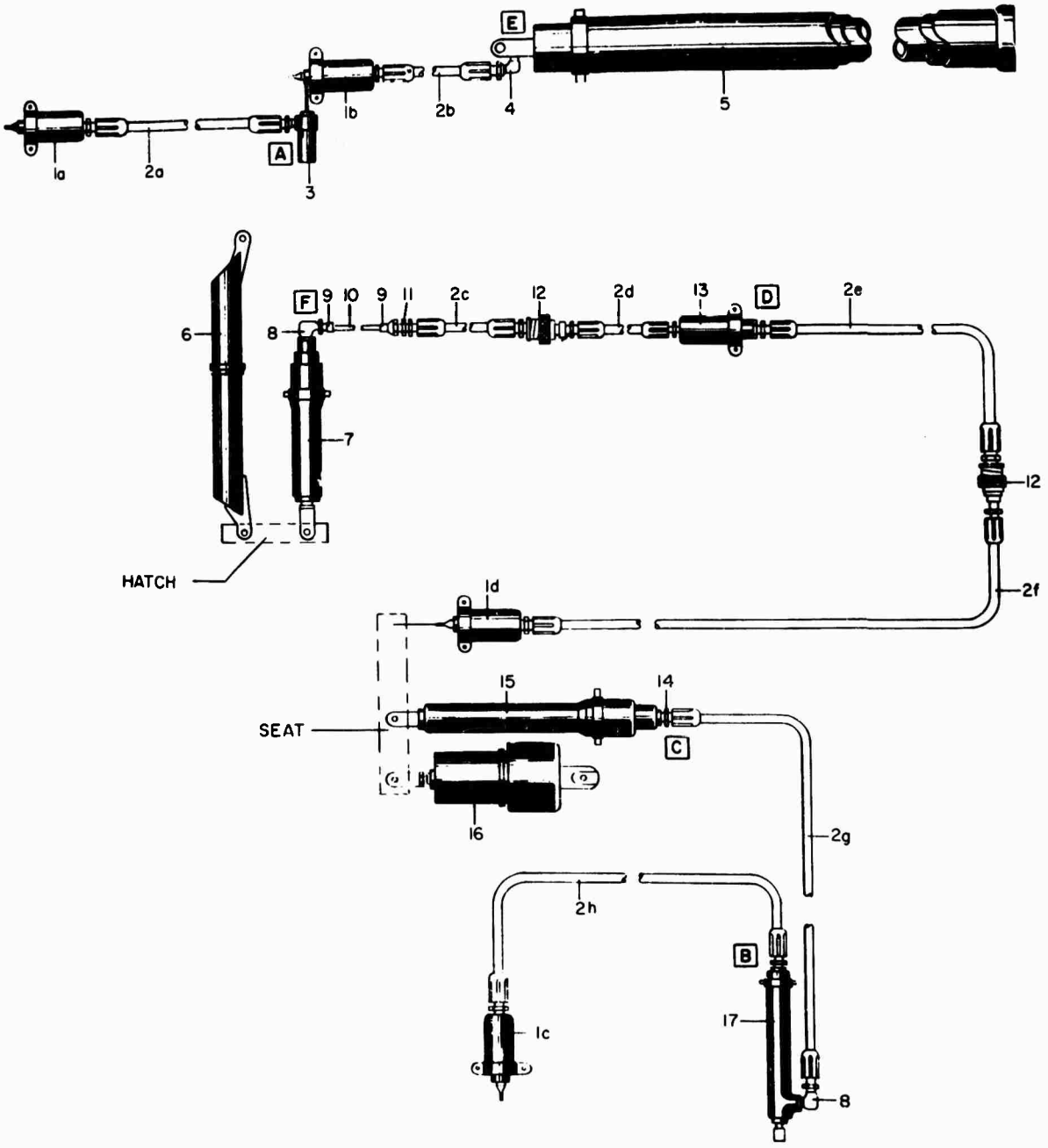

Figure 4. Electronic counter measures operator escape subsystem, B-52 Airplane

Hatch Jettison and Downward Seat Capsule
Escape Subsystem
(Figure 5)

1. Initiator, M3
2. Nut, AN818-4
   Sleeve, AN819-4
3. Tubing, corrosion-resisting, 1/4 in. OD, 0.049 in wall, Spec MIL-T-8606, Type I
   a. Length, 12.00 in.
   b. Length, 14.00 in.
   c. Length, 11.00 in.
   d. Length, 3.00 in.
   e. Length, 11.75 in.
   f. Length, 24.00 in.
   g. Length, 8.00 in.
   h. Length, 11.00 in.
   i. Length, 24.00 in.
   j. Length, 18.00 in.
   k. Length, 7.00 in.
   l. Length, 3.00 in.
4. Wiggins coupling assembly 4305D4, 4302D4
5. Union, AN832-4
   Nut, AN924-4
   Washer, AN960D716
6. Hose Assembly, MS28741-4
   a. Length, 30.0 in.
   b. Length, 38.0 in.
   c. Length, 32.0 in.
   d. Length, 14.0 in.
   e. Length, 26.4 in.
   f. Length, 20.0 in.
   g. Length, 10.75 in.
7. Grommet, AN931A11S16
8. Valve, AN6249-4
9. Cylinder, initiator, Boeing Airplane Co Dwg No. 6-62493-1
10. Cross, AN827-4
11. Union, AN815-4
    Gasket, AN6290-4
12. Initiator, Delay, M10
13. Nut, AN818-4
    Sleeve, AN819-4
14. Nut, AN924-4
    Washer, AN960D716
15. Elbow, AN833-4
16. Union, AN832-4
    Nut, AN6289-4
    Gasket, AN6290-4
    Ring, AN6291-4
17. Thruster, M1A1
18. Thruster, M5A1
19. Catapult, M4
20. Elbow, AN822-4
21. Tee, AN824-4
    Nut, AN924-4
    Washer, AN960D716

PRESSURE DATA

Location	Pressure (psi) Max	Avg	Min	
A	1190	1070	950	
A'	1700	1520	1060	- two initiators
B	1200	1020	860	
B'	1650	1450	1020	- two initiators
C	1160	970	850	
D	5540	4900	4430	
E	3370	3220	3090	
F	2210	2130	2050	
G	2260	2180	2130	

Neg. #30889
R-1363

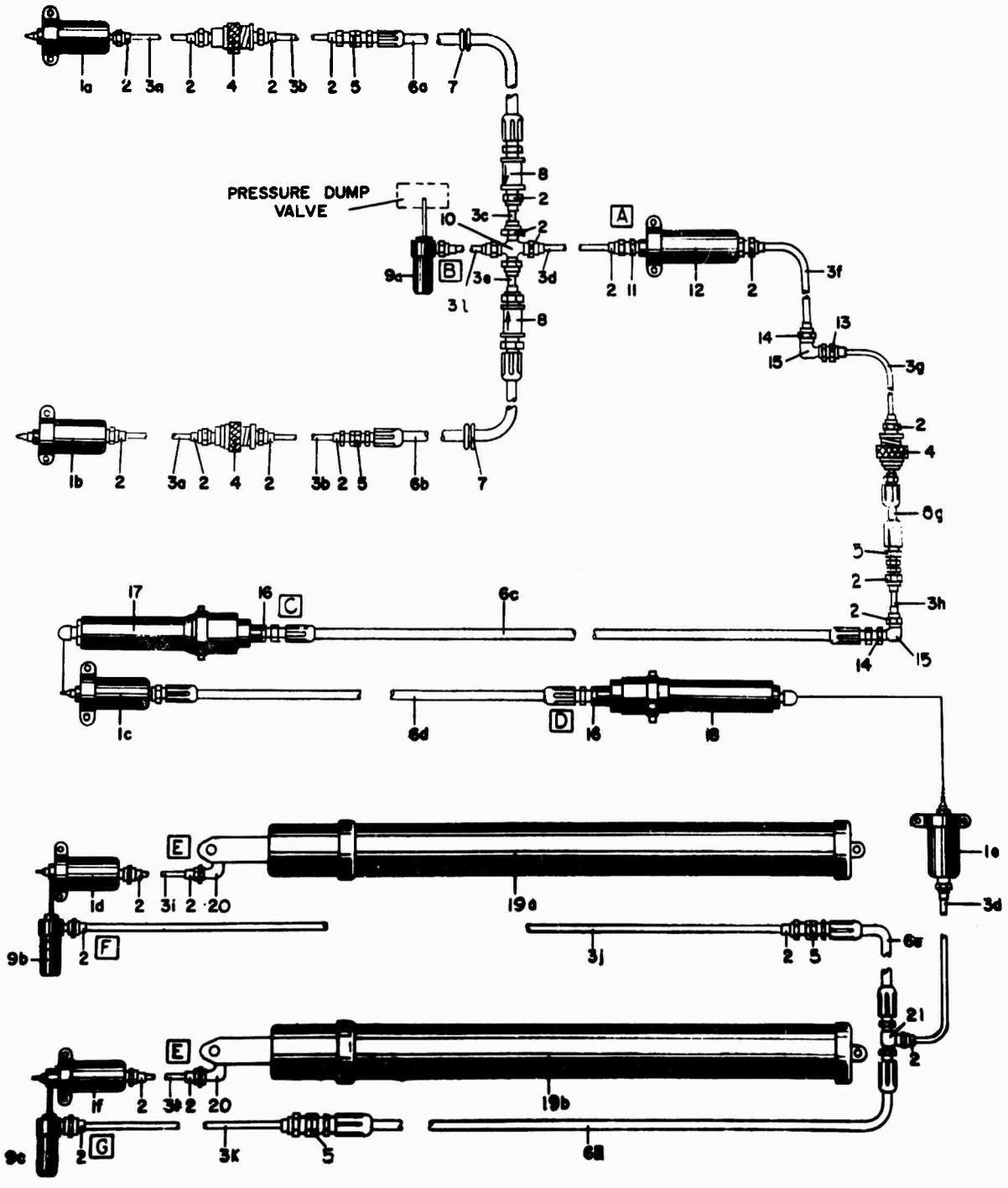

Figure 5. Hatch jettison and downward seat capsule subsystem, RB-52 Airplane

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